INSTRUCTION MANUAL

NUMBER B-3610
AUGUST 1967

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MARK VI SENSITOMETER

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FT 118G 534-8650-856

MP MASTER
MA28900

ELECTRO-OPTICS DIVISION
EG&G, INC., 35 CONGRESS ST., SALEM, MASSACHUSETTS 01970

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ADDENDUM 1

MARK VII SPECIFICATIONS AND SCHEMATIC

1. The Mark VII Sensitometer is similar to the Mark VI in operation. Specifications for the Mark VII are as follows:

Position	10^{-2}	10^{-3}	10^{-4}	10^{-5}	10^{-6}
Nominal Pulse Length (sec)	0.01	0.001	0.0001	0.00001	0.000002
Integrated Output as a % of Output in 10^{-4} Position	*90-110%	*90-110%	100%	90-110%	20-25%

2. A charging time of 15 seconds should be allowed between flashes when using the 10^{-5} circuit. Allow five seconds between flashes on all other circuits.

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* Using attenuators provided with the equipment.

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The EG&G, Inc., Mark VI Sensitometer (Fig. 1) is a precision photographic research tool which utilizes a xenon flash source. The Mark VI produces precise 10^{-2}, 10^{-3} and 10^{-4} sec flashes of daylight quality light. Designed to serve as the exposure light source for film characteristics investigations, process control operations, and reciprocity effects studies, the Mark VI can be used with all types of photographic emulsions. Since the light output approximates the color quality of daylight, no color compensation is required for testing black and white or daylight-type color emulsions. A versatile instrument, the Mark VI has light outputs sufficient to test the slowest and fastest emulsions and flash durations which approximate the exposures encountered in snapshot, electronic flash, and high-speed motion picture photography.

1.1 SPECIFICATIONS

Exposure Time (Flash Duration):	10^{-2}, 10^{-3}, or 10^{-4} sec
Light Output (Nominal Values): (Sufficient for films ASA-1 and faster)	1000 MCS* at 10^{-2} sec 5000 MCS at 10^{-3} sec 130 MCS at 10^{-4} sec
Repeatability:	Within ± 3% from flash to flash
Flatness of Light:	Within 6% across the exposure plane
Spectral Character:	Daylight-quality (Fig. 2)
Recycle Time:	5 sec (Fig. 3)

*Meter-candle-seconds

Exposure Window Area	1-in. x 4-1/2-in. (accomodates various photosensitive materials including films and glass plates)
Input Voltage	115 + 15v, -20v, 50/60 Hz*
Size	11-in. x 13-in. x 16-in.
Shipping Weight	25-lb.

1.2 DESCRIPTION

The Mark VI Sensitometer, a self-contained unit housed in a molded plastic case, is solidly constructed and conveniently sized for inclusion in any modern darkroom arrangement. Four operating controls (ON-OFF toggle and 10^{-2}, 10^{-3}, and 10^{-4} SECOND EXPOSURE TIME selector switches) are located on the front panel of the instrument. A fifth control (trigger switch) is located under the hinged cover platen at the top of the instrument. Closing the cover platen accomplishes triggering. A socket is provided on the right of the base so that the user may also trigger the unit remotely. (A mating two-pronged male plug is provided. The remote cable and switch must be provided by the user.)

The sensitometer operates on standard 115V, 50/60 Hz, a-c power. A built-in voltage regulator circuit prevents change in light output with line-voltage fluctuations from 95V to 130V. The time constants of the three different RC circuits provide three precise duration flashes at three different energy levels. The highest output, approximately 5000 meter-candle-seconds (MCS), is obtained from the 10^{-3}

*Unit can be provided for 230 V - 50/60 Hz.

Fig. 1. The EG&G, Inc., Mark VI Sensitometer, front view.

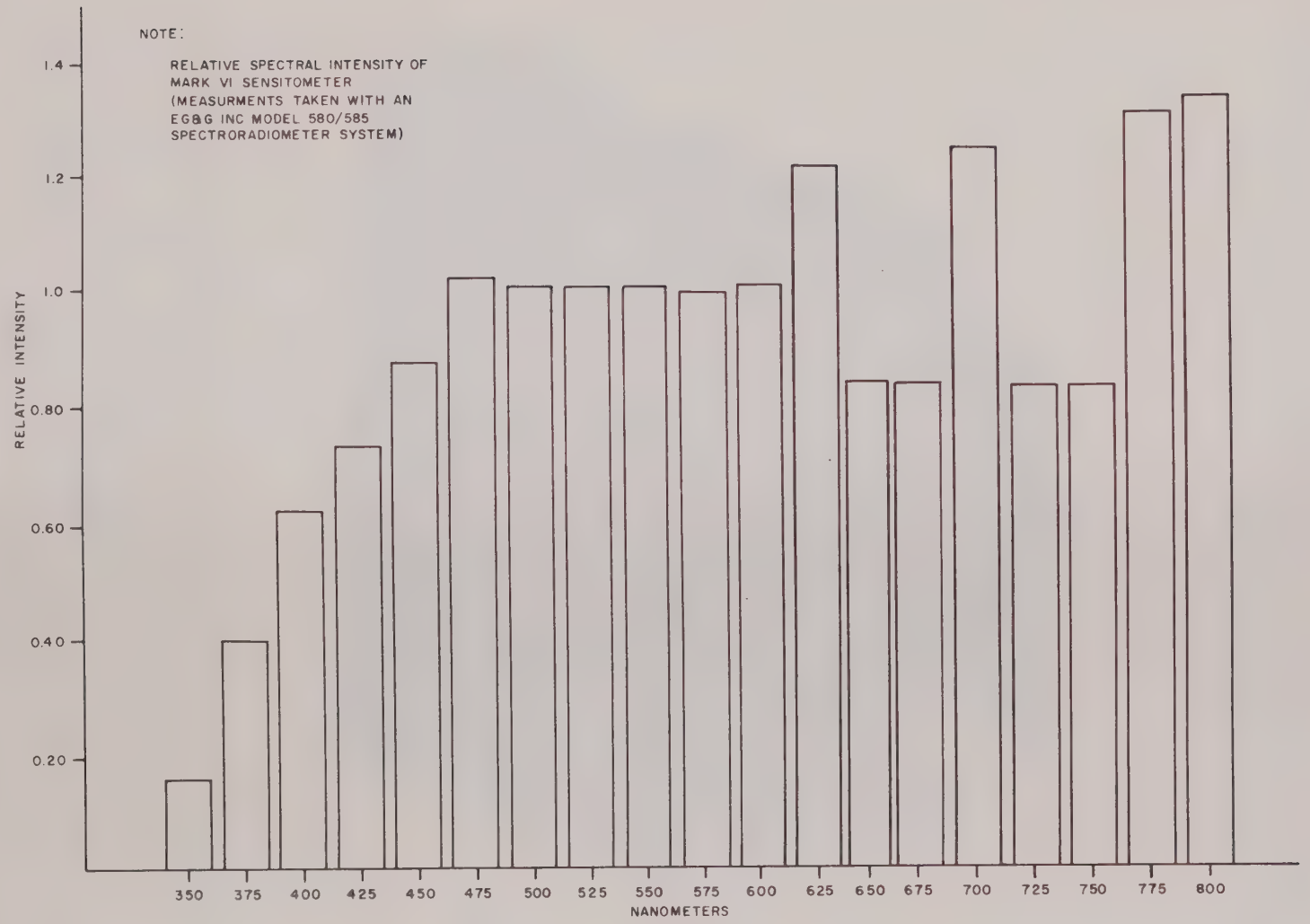

Fig. 2. Typical spectral output distribution of Mark VI Sensitometer.

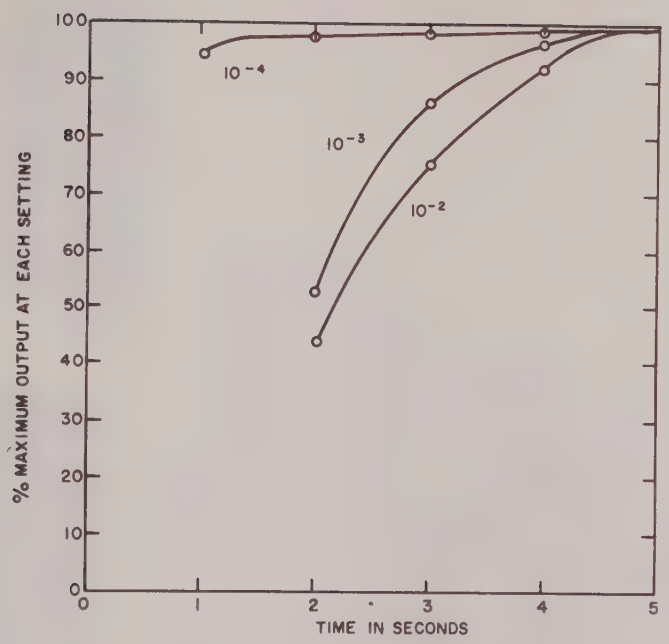

Fig. 3. Charging time characteristics of flash circuits in Mark VI Sensitometer.

sec circuit. The 10^{-2} and 10^{-4} sec circuits deliver approximately 1000 and 130 MCS, respectively.

The complete Mark VI System (Fig. 4) consists of the sensitometer, a gray-scale box, flashtube shield, two variable-area filters, and a Kodak No. 2 Photographic 21-Step Tablet (uncalibrated*). The gray-scale box, which is inserted into the body cavity under the platen of the instrument, provides the exposure platform upon which the film undergoing test is exposed. The variable area filters (3-line and

*Calibrated photographic step tables may be obtained from Kodak, Ansco, Macbeth, etc., or the user may easily calibrate the scale provided.

Fig. 4. Complete Mark VI System.

19-line), which are inserted between the flashtube shield and the gray-scale box, allow the user to balance the light output of the three separate circuits within ± 10%. The 3-line filter and the 19-line filter, which can be considered equivalent to ND 1.70 and ND 1.0 filters, respectively, are used to normalize the light output of the 10^{-3} and 10^{-2} sec circuits to that of the 10^{-4} sec circuit. Normalization of the light output of the three circuits is useful in studying film characteristics and exposure reciprocity effects. The step tablet (not shown in Fig. 4) is supplied as an exposure modulator. Neutral density filters, such as the Wratten 96 series, can also be used to reduce the light output of the individual circuits to suit the needs of the specific film being tested. Neutral density filters are not recommended for color work, however.

2.1 STEP TABLET CALIBRATION

Initially, before the Mark VI is employed in any testing, the 21-step tablet supplied with the instrument must be calibrated. This is done quite simply with a reliable densitometer. The printing density (diffuse density) must be determined for each of the 21 steps of the scale. Any convenient graphing technique can be used for recording and plotting the densitometer information. In this manual the recording and plotting instructions are given based on the formats used at EG&G.

The diffuse density of each step is read and then recorded on the abscissa (horizontal axis) of graph paper. As will be noted in Fig. 5, this axis has been marked off in 30 equal divisions of 0.1 to correspond to the range of density from 0 to 3.0. The step-tablet densities then serve as the log relative E values of each step. Vertical lines are drawn from these points as an aid for plotting film characteristic curves (Fig. 6). The precise repeatability of the Mark VI output is such that the step-tablet densities provide fixed and repeatable values of exposure for each instrument. Figure 7 shows the results of a life test during which the 10^{-3} sec circuit was triggered 200,000 times at 10-sec intervals. Even after this unrealistic continuous use, the light output had decreased by only 15%.

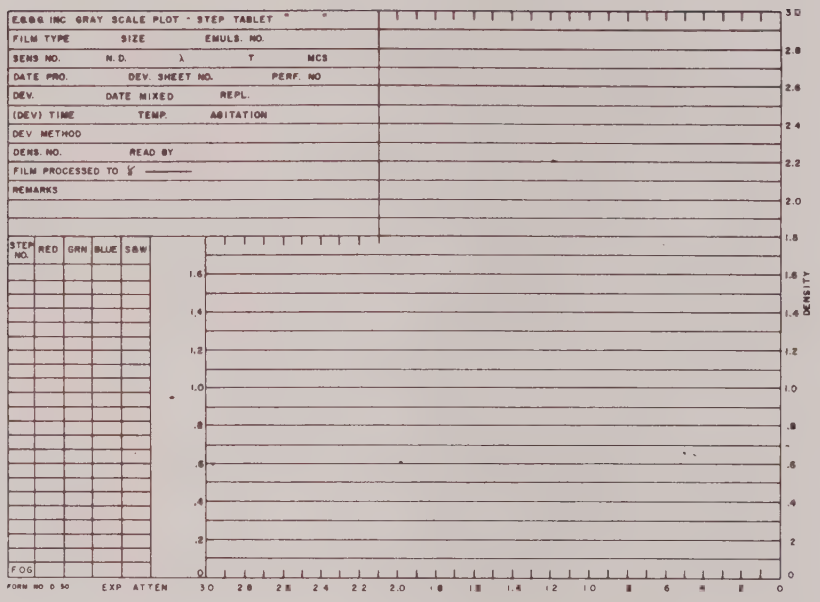

Fig. 5. Basic EG&G exposure plot form.

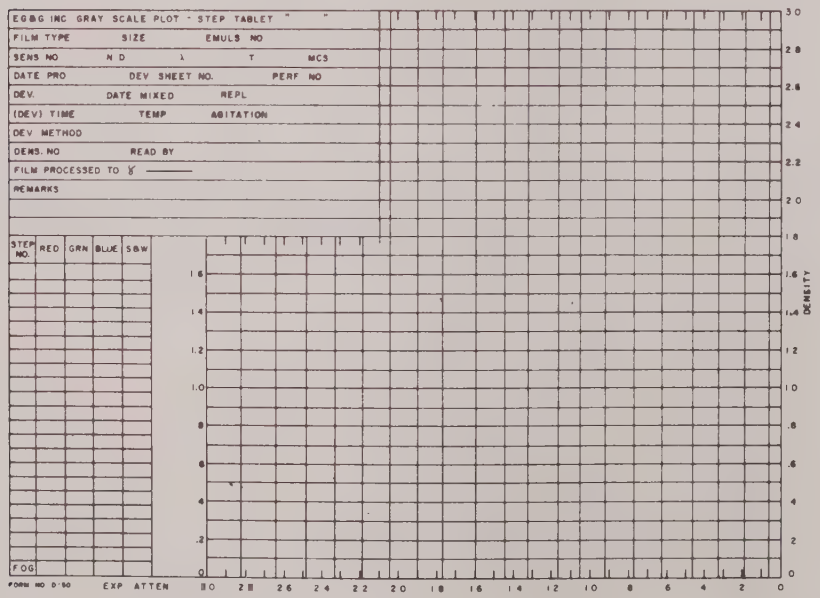

Fig. 6. Plot form with step-tablet densities marked.

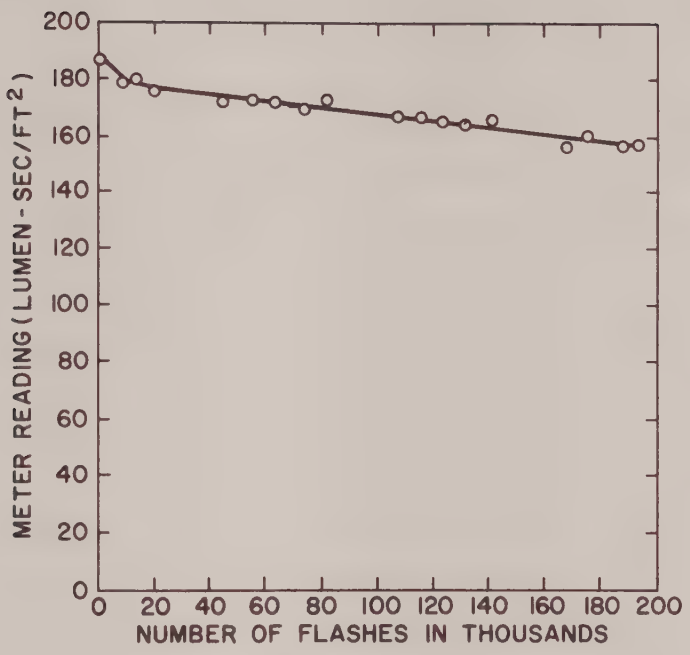

Fig. 7. Light output vs tube life.

Once the exact densities of the step-tablet have been measured and recorded, they can then be used as the log relative exposure values for plotting exposure characteristic curves. After calibration of the step tablet and construction and production of the necessary plotting forms (see Section 3, Operation), the various sensitometric tests can be undertaken.

2.2 CHARACTERISTIC CURVE GENERATION

In all sensitometer applications, the user will be concerned with generating characteristic curves. Having determined the exposure time

needed and the processing factor to be investigated (see Section 3, Operation), the Mark VI is connected to a suitable source of power and the following procedure is used.

1. Insert the necessary variable area and/or neutral density filter over the flashtube shield.
2. Insert the gray-scale box (make sure the glass is clean).
3. Place the step tablet, emulsion side up, on the gray-scale box window. Insert the ends in the slots provided for this purpose.
4. Turn the ON-OFF toggle to ON.
5. Depress the necessary EXPOSURE TIME switch.
6. Raise the hinged cover platen.
7. Extinguish all darkroom lights.
8. Insert a suitable length of test film in the notches at the top of the gray-scale box. (The notches at either end of the gray-scale box faceplate can be used for positioning 16, 35 and 70 mm films.)

NOTE

The film is placed above the step tablet, emulsion side down, with the step tablet directly over the glass face of the gray-scale box. Sixteen mm films are butted against the upper edge notch, 35 mm are butted against the lower one.

9. Lower the platen until the unit triggers. (The audible click of the microswitch will be noticeable. This serves as an indicator that an exposure has been made.)

10. Raise the platen, remove the film strip, and process as prescribed.

When these steps have been performed, the user will have a test film from which the characteristic curve, gamma, and film speed can be determined. Densities of the processed film can now be measured on a densitometer, and the film density vs exposure attenuation (step-tablet density) can be plotted (see Fig. 8).

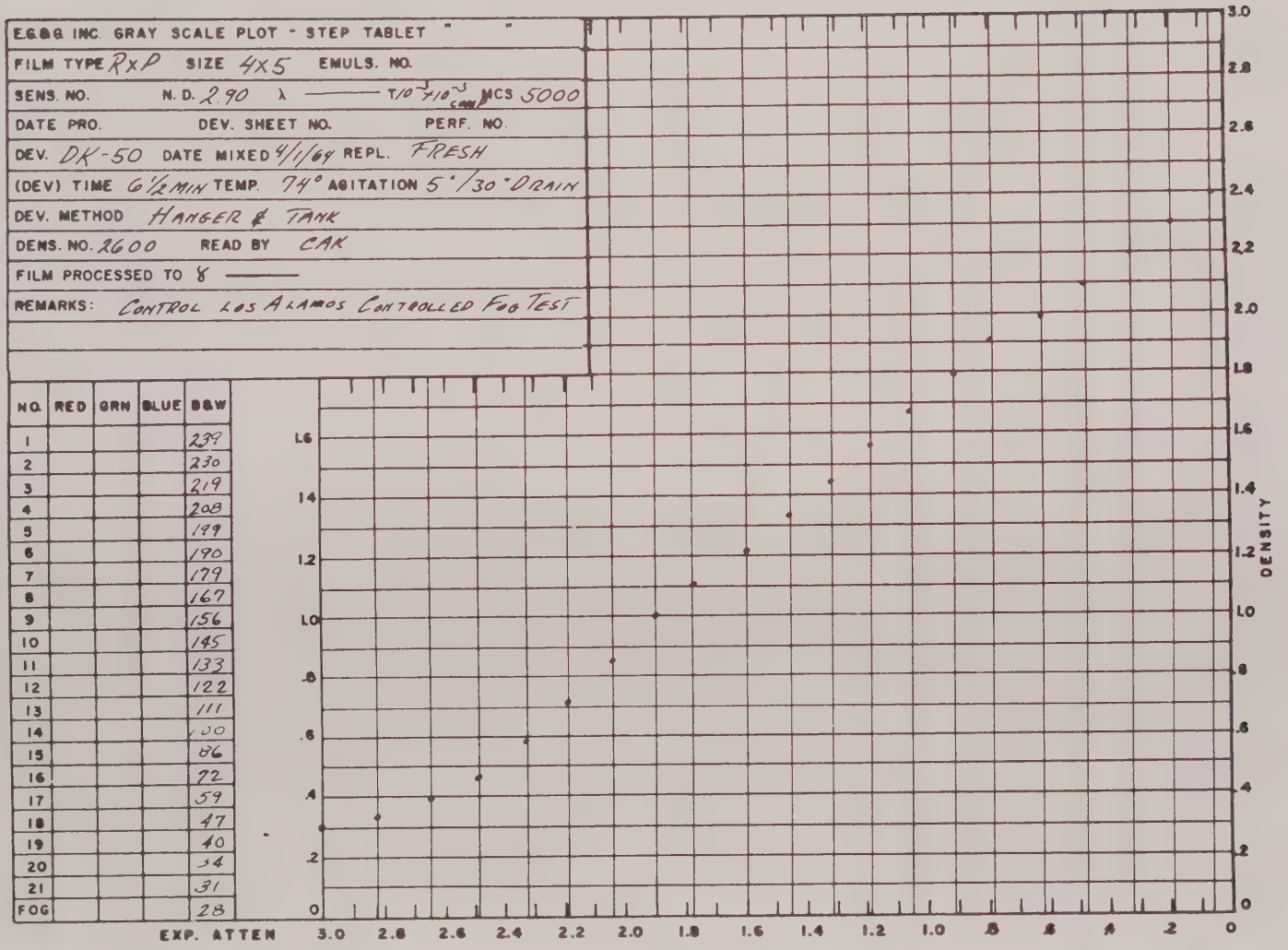

Fig. 8. Typical step-tablet density plot.

SECTION 3

OPERATION

The complex interrelation and dependency of the separate variables of the photographic process (film, exposure, processing schedule) are such that a hit-and-miss approach to the process will rarely result in useful quantitative photographic data. This being the case, any procedure or tool which leads to consistent production of a desired photographic record is worthwhile. The EG&G Mark VI Sensitometer is an instrument with which standardization can be accomplished. With it, the complex photographic variables can be analyzed, separately and scientifically. The precise duration and constant repeatability of the light output of the Mark VI makes it possible to consider all aspects of the photographic process from the point of view of exact, controlled exposure. Film characteristics and the effects of processing conditions can be determined easily and precisely with this sensitometer.

3.1 FILM CHARACTERISTICS DETERMINATION

For studies of film characteristics such as contrast, speed, and fog, the sensitometer is used for generating a "characteristic" curve for the particular film of interest. This should be done using the manufacturer's recommended exposure and development schedule. The exposure time (10^{-2}, 10^{-3}, or 10^{-4} sec) used for the test strip should be one that is in the range recommended for the type of photographs that will generally be made.

The following list gives a general guide for the additional filtration* necessary when exposing films of different ASA ratings using a typical Mark VI Sensitometer. This filtration is based on the light output of the 10^{-2}, 10^{-3}, or 10^{-4} sec circuits with the proper variable-area filter in place.

ASA Numbers		ND Filter
Exposure Index	Speed Value	
10	1.5^{o}	1.0
32	3^{o}	1.5
100	5^{o}	2.0
320	6.5^{o}	2.5
1000	8.5^{o}	3.0
3200	10^{o}	3.5

After exposing and processing the test filmstrip, the resulting densities should be measured and plotted on graph paper in the form of an H & D film characteristic curve. As noted in the example of a typical film presented in Fig. 9, the curve exhibits three distinct regions: (1) a toe (A to B) where the slope continuously increases from zero up to a maximum value; (2) a straight-line portion (B to C) over which the slope is a constant maximum value; and (3) a shoulder region where the curve slope decreases as the film becomes saturated with exposure.

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*Kodak Wratten 96 series or equivalent.

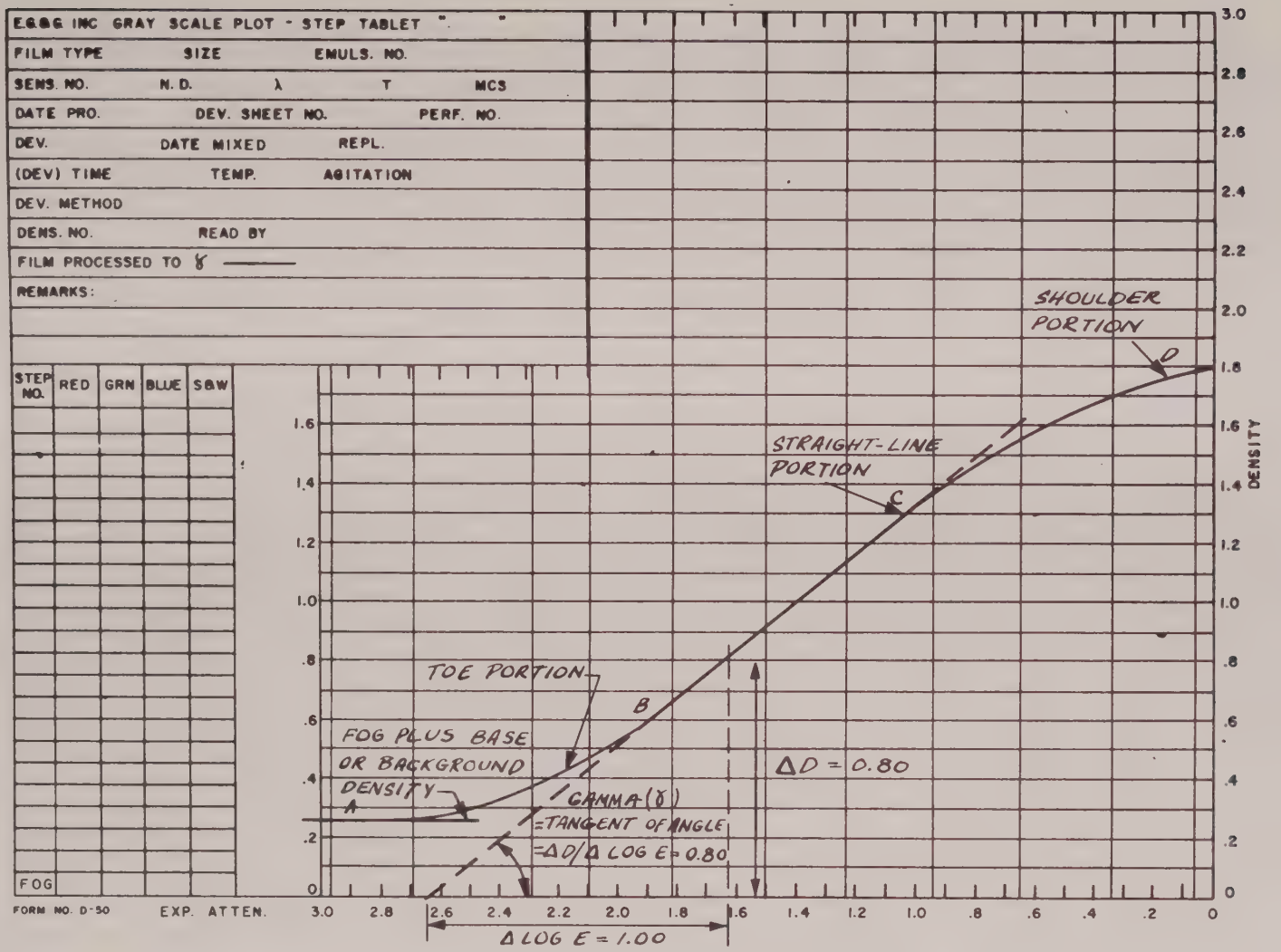

Fig. 9. Typical H&D characteristic curve.

The straight-line portion of constant slope is the region from which the value of gamma (γ) is derived. The numerical value of gamma is the tangent of the angle which an extension of the straight-line portion of the curve makes with the abscissa or exposure axis. The value of gamma increases with increasing film development and results in greater contrast but reduced exposure latitude.

The range of scene brightness values which can be reproduced undistorted by a photographic film is indicated by the length of the straight-line portion of the curve. Prolonged development increases gamma and usually decreases the length of the straight-line and, hence, latitude. This is termed the linear exposure latitude of the film. The useful exposure latitude is somewhat greater because it includes portions of the toe and shoulder. The total scale includes all of the toe, straight-line portion, and shoulder region of the H&D curve.

Using the nominal MCS values as published in this manual (Section 1), the approximate speed of a film can be determined using the method adopted by the American Standards Association.* Using the Mark VI as the light source, the user should expose a series of test films and then develop these (using different developing times) to achieve curves which display the exposure-density characteristics shown in Fig. 10.

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*Refer to ASA method for determining "Speed of Photographic Negative Materials," PH2.5-1960.

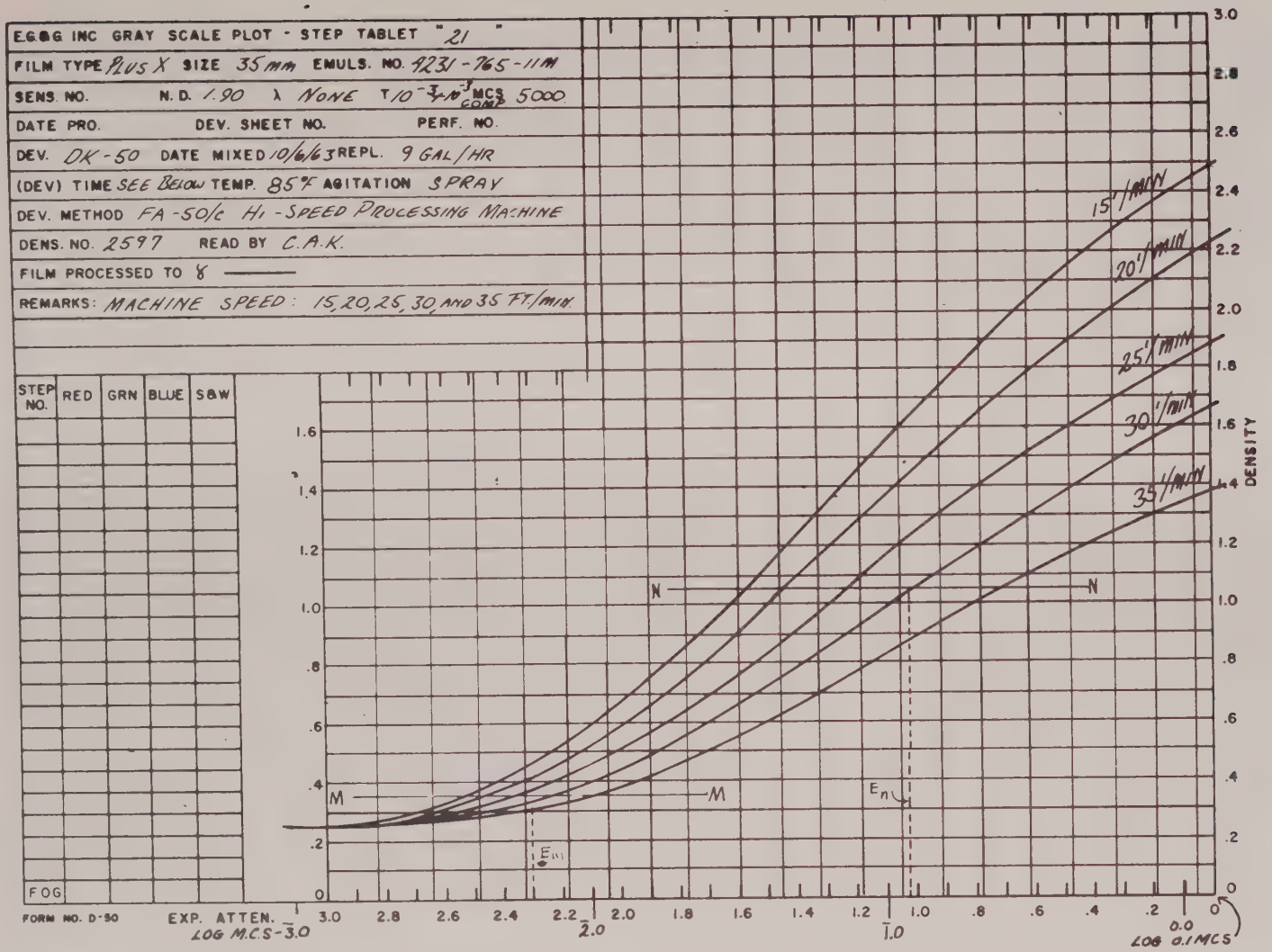

Fig. 10. Effects of time of development on film density.

The relative values of the abscissa are step tablet densities or exposure attenuation values and must be converted to meter-candle-seconds (MCS) in order to calculate film speed. The MCS output of the light pulse used in exposing the series of sensitometric strips is selected from the nominal values listed in Section 1. The amount of light reaching the step tablet will be reduced by the effect of the light compensator and ND filters which may be used. In the example of Fig. 10, the 10^{-3} sec light pulse emits a nominal 5000 MCS, the logarithm for which is 3.7. This is attenuated by the effective 1.7 density of the 10^{-3} compensating attenuator in addition to the ND 1.9 filter. Thus the exposing light pulse incident upon the step tablet is log 3.7 -1.7 -1.9 = log 0.1 MCS. This is the log MCS value assigned to the zero attenuation position on the abscissa of Fig. 10.

Determination of the film speed is now made by selecting that H & D curve which most closely approximates the shape conditions specified in ASA PH2.5-1960. Referring to Fig. 10, a horizontal line, M, is drawn through the toe region of the family of curves at a density value of 0.10 above background density. Another horizontal line, N, is then constructed which passes through the curve family at a density of 0.70 above the first line. That curve is then chosen whose intersections with both horizontal lines, M and N, are separated by a log exposure difference of approximately 1.3. These conditions are best satisfied by the curve designated 30'/min. The horizontal line, M, intersects the toe of this curve at a log exposure, Em, of $\overline{3}$.78 MCS whereas line N

intersects the curve at a log exposure, En, of $\overline{1}.05$ MCS for a difference of slightly less than log 1.3.

Determination of the speed is next computed by use of the formula:

$$Sx = \frac{0.8}{Em} = \frac{0.8}{0.006 \text{ MCS}} = \text{ASA } 133$$

where Sx is the ASA number and Em is expressed in meter-candle-seconds. (Em = log $\overline{3}.78$ MCS = 0.006 MCS)

The fog value is normally defined as the base-plus-fog density of a developed, but unexposed, area of the film (see Fig. 9) and is indicative of the developer condition and emulsion aging. (These conditions tend to increase the fog-density which results in an apparent decrease in slope.)

Repeated generation of characteristic curves for the films of interest will serve to firmly establish the response of the particular film for a particular emulsion batch number.

3.2 PROCESS CONTROL OPERATION

The Mark VI Sensitometer is the key instrument for successful process control operations. In such operations, a series of characteristic curves should be generated for each film. The first curve should be obtained using the particular exposure and development conditions recommended by the manufacturer. After this, a series of subsequent curves should be plotted at the same exposure time but with one of the

processing variables (time or temperature) varied over a predetermined range. The resultant series of curves will show the relation of density and exposure as affected by time of development (Fig. 10) and temperature (Fig. 11). This is the family of processing characteristic curves for the particular emulsion.

Curves of time-gamma (Fig. 12) and temperature-gamma (Fig. 13) can be constructed from the family of processing characteristic curves generated for a particular film-developer combination. These are made by plotting gamma versus the particular variable (time or temperature as read from the individual curves of the family) of interest. Since gamma is defined by the slope of the straight-line portion of the characteristic curve (a tangent function), gamma values can easily be read directly from each family of curves. Lines drawn through the straight-line portions of each of the curves in the family of curves to a point of intersection will determine the tangent angle reference point from which tangent value readings can be made. One merely chooses a point ten abscissa units removed from the point of intersection and then reads the ordinate density value at the intersection of the perpendicular from this point and the particular curve (time or temperature). Whether the intersection occurs at the abscissa, as it does in Figs. 9 and 10, or above or below, does not matter – one simply uses the same ordinate and abscissa values and measures from the point of intersection.

By referring any subsequent characteristic curve to the gamma-variable plots, the processor can monitor his processing schedule. Any

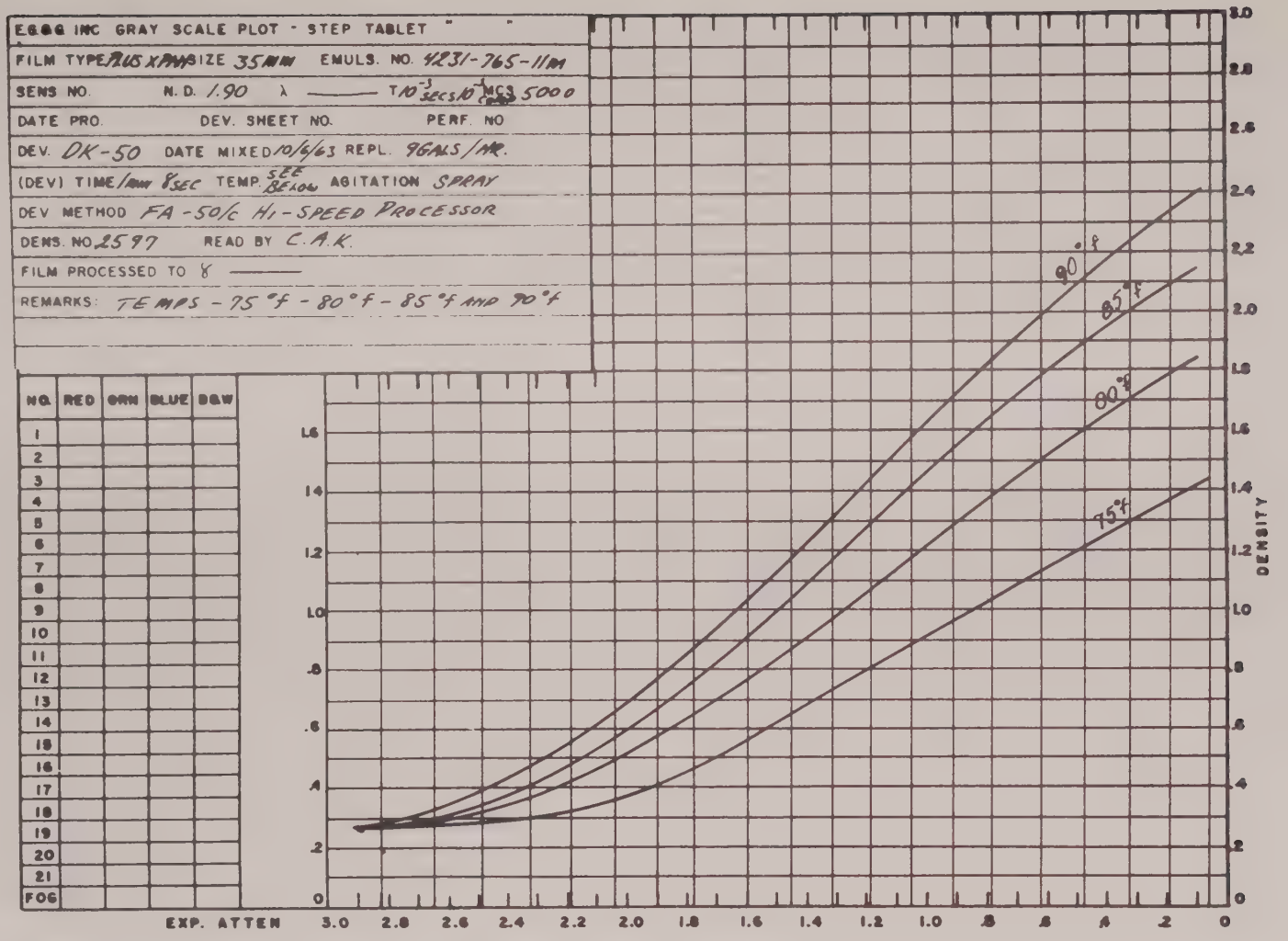
E.G.&G. INC GRAY SCALE PLOT - STEP TABLET
FILM TYPE PLUS X PAN SIZE 35MM EMULS. NO. 4231-765-11M
SENS NO. N.D. 1.90 λ ——— T 10⁻³ secs 10⁻⁶ MCS 5000
DATE PRO. DEV. SHEET NO. PERF. NO
DEV. DK-50 DATE MIXED 10/6/63 REPL. 96 ML'S/MR.
(DEV) TIME 1MIN 8 SEC TEMP. SEE BELOW AGITATION SPRAY
DEV METHOD FA-50/C HI-SPEED PROCESSOR
DENS. NO. 2597 READ BY C.A.K.
FILM PROCESSED TO 8 ———
REMARKS: TEMPS - 75°F - 80°F - 85°F AND 90°F
NO. RED GRN BLUE B&W
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 FOG
90°F
85°F
80°F
75°F
DENSITY
EXP. ATTEN
3.0 2.8 2.6 2.4 2.2 2.0 1.8 1.6 1.4 1.2 1.0 .8 .6 .4 .2 0
FORM NO. D-40

Fig. 11. Effects of temperature on film density.

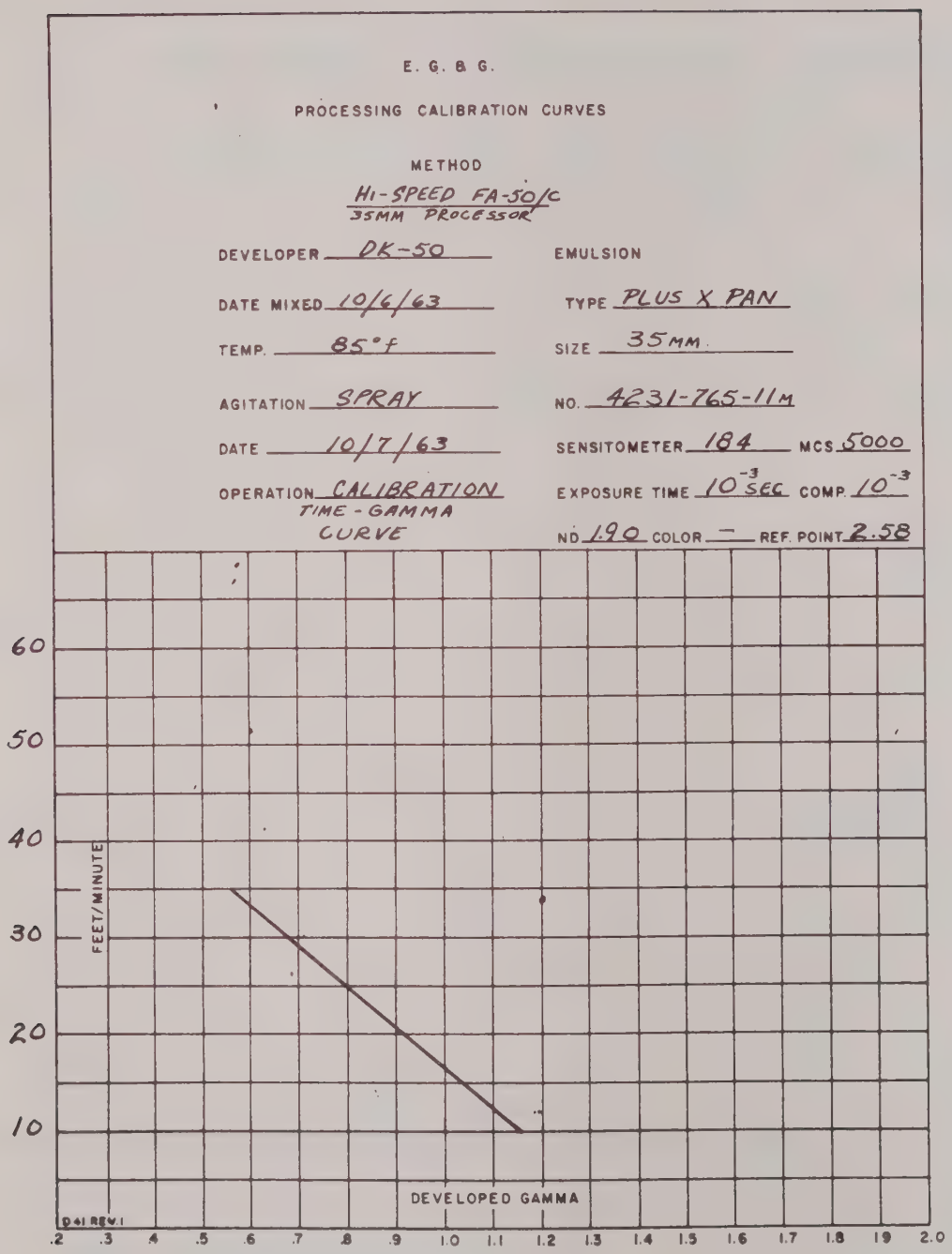

Fig. 12. Time-gamma curve.

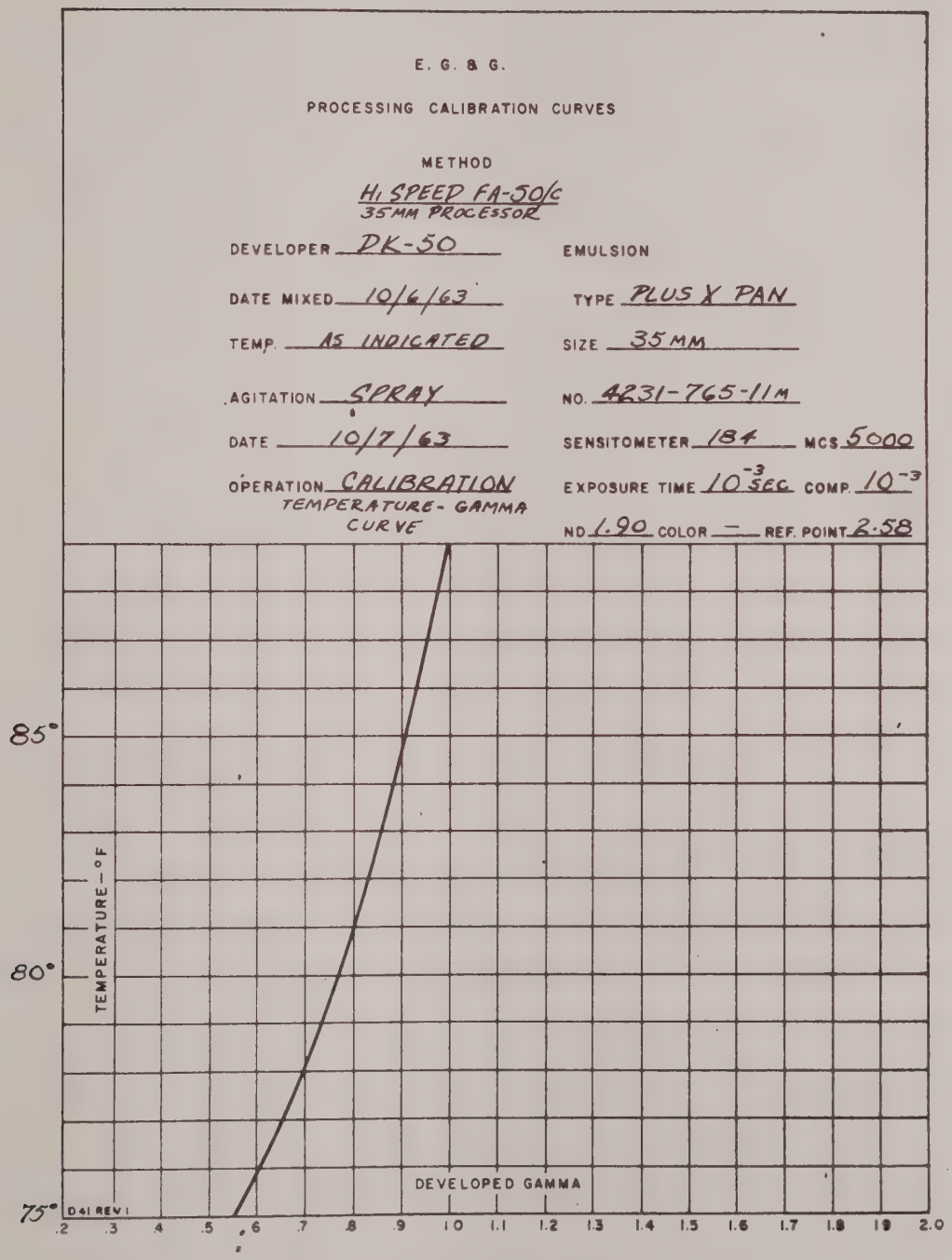

Fig. 13. Temperature-gamma curve.

displacement in subsequent curves would show that a change has occurred in the processing. The direction of the shift and the record of the particular processing operation would give some indication of the factor causing the change. In the case of routine processing, generation of an occasional characteristic curve should suffice to warn of any change in the processing. For critical processing, test strips would be run and read prior to actual film processing. In addition, exposed (but not processed) test strips may be affixed to the beginning and end of both hand and machine-processed films. This would yield a record of any change occurring during processing. All such test strips would naturally be of the same type of film as that being processed (from the same lot number, if possible). They would also be given the sensitometric exposure that best approximates those received by the film to be processed.

The degree of agitation during development has a marked effect upon the quality of the final record. Although increased agitation will increase the slope (gamma) of the characteristic curve (as in the case with time and temperature), the most significant effect that agitation has is its effect on the shape of the characteristic curve. Two identical films given the same exposure and developed to the same gamma* using different agitation schedules (Fig. 14) resulted in curves with shoulder portions that show substantial deviation. These deviations represent what would constitute an unpredictable distortion in the tonal values of

*The time or temperature was decreased as agitation was increased to achieve the same gamma.

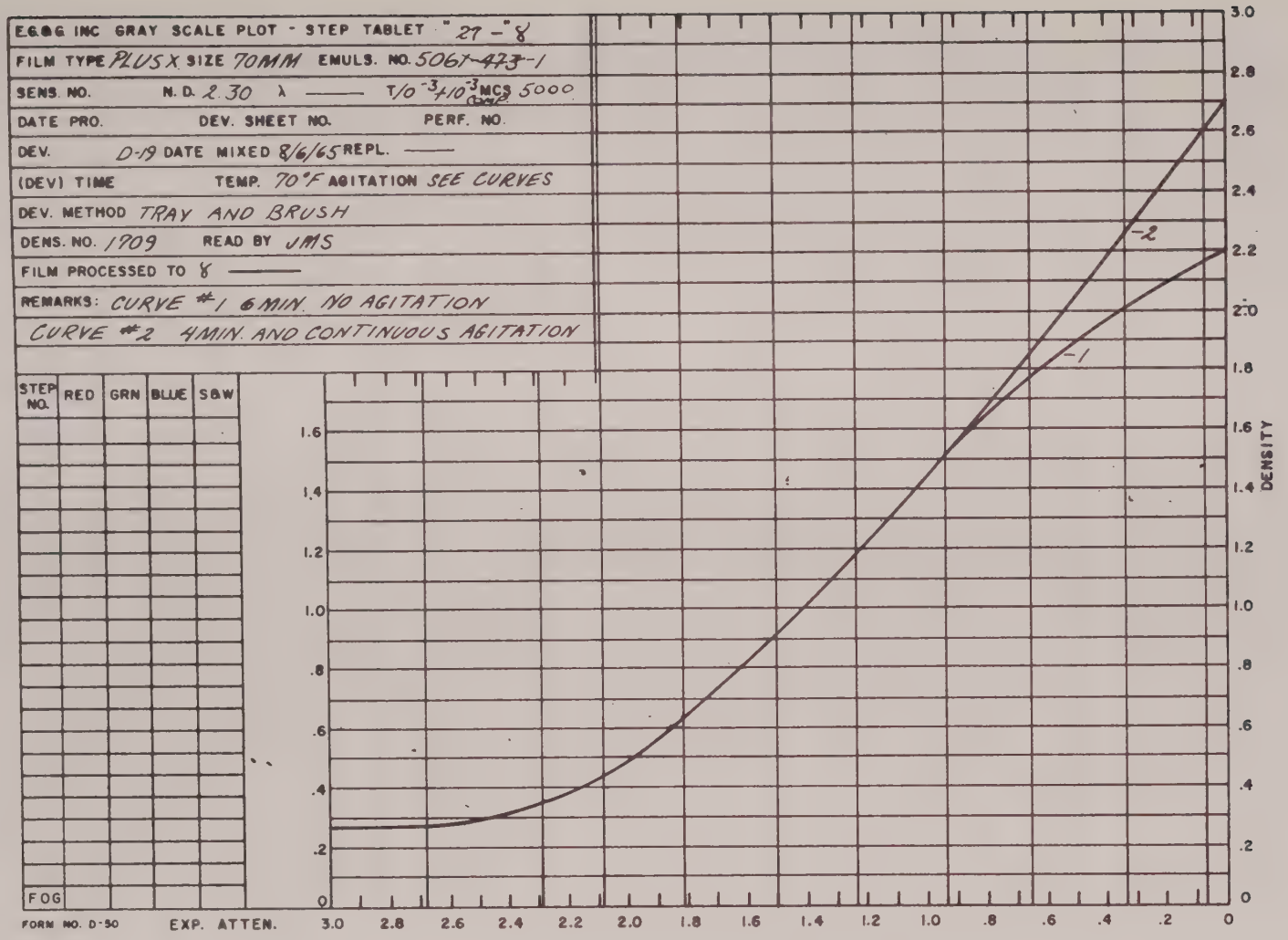
EG&G INC GRAY SCALE PLOT - STEP TABLET "27 - "8
FILM TYPE PLUS X SIZE 70MM EMULS. NO. 5061-473-1
SENS. NO. N.D. 2.30 λ ——— T/0 -3 +10-3 MCS 5000
DATE PRO. DEV. SHEET NO. PERF. NO.
DEV. D-19 DATE MIXED 8/6/65 REPL. ———
(DEV) TIME TEMP. 70°F AGITATION SEE CURVES
DEV. METHOD TRAY AND BRUSH
DENS. NO. 1909 READ BY JMS
FILM PROCESSED TO 8 ———
REMARKS: CURVE #1 6 MIN. NO AGITATION
CURVE #2 4 MIN. AND CONTINUOUS AGITATION
STEP NO.
RED
GRN
BLUE
S&W
FOG
FORM NO. D-50
EXP. ATTEN.
3.0 2.8 2.6 2.4 2.2 2.0 1.8 1.6 1.4 1.2 1.0 .8 .6 .4 .2 0
DENSITY
-1
-2

Fig. 14. Effects of agitation on film density.

the final film record. If no agitation is given, muddy and uneven highlights might result in the final picture and the film would suffer from a noticeable decrease in exposure latitude.

3.3 RECIPROCITY EFFECTS STUDIES

Photographic exposure is the product of two terms, intensity and time, as indicated by the photographic law of exposure reciprocity. This law states that the photographic effect (density resulting from exposure and processing) should be the same whether high or low intensity illumination is used provided that the duration over which it acts is maintained in an inverse relation to the intensity.

It has long been known that this law is not always valid; its failure is most evident at the extreme conditions of exposure. With very high intensity and inversely proportional short exposure duration conditions, a photographic emulsion responds in a manner markedly different from conditions of lower intensity and correspondingly longer exposure times.

Such anomalies of exposure reciprocity are satisfactorily explained by the present day theory of latent image formation. This theory includes a mechanism whereby the silver halide crystals respond inefficiently to high values of energy flux. The high flux of energy is considered to be the cause of the inefficiency, hence the expression "high intensity failure." Since high speed photography more or less implies short duration exposure, the engineer or photographer employing high

speed photography is accustomed to thinking in terms of time failure rather than intensity failure.

Published data concerned with exposure reciprocity are usually presented as curves showing the relation between log exposure and log intensity for a given developed density level (usually 1.0 above background). Such a presentation can lead to a considerable amount of ambiguity because it describes only one point on the exposure characteristic curve. Unless a considerable range of the H & D curve is presented, the response of a photographic material to certain conditions of exposure cannot be determined. The complete exposure response can be properly shown only by means of a family of H & D curves. Comparison of the shape and position along the exposure axis of such curves gives a true measure of the response of photographic materials to different exposure conditions.

The Mark VI, because of the precise duration and repeatability of its 10^{-2}, 10^{-3}, and 10^{-4} sec circuit outputs, is an ideal tool for exposure reciprocity effects studies. With this instrument, the reciprocity effect for a given film can be demonstrated, simply by generating separate characteristic curves using each of the separate exposure time settings with the required variable-area compensator in place. Since the total light output in the film plane is nearly constant for all circuits when the compensators are inserted, each film would be receiving the same exposure as the product of the different intensity-time factors. Any shift in the resultant characteristic curve from that

achieved at the standard exposure duration would indicate the effect of exposure reciprocity.

4.1 MAINTENANCE

In view of the quality of the components used in the Mark VI Sensitometer, the quality control procedures exercised at EG&G, Inc., and the conditions to which precision photographic instruments are exposed, little maintenance will be required. Should fuse or flashtube replacement be necessary during the life of the unit, these are easily accomplished. Should any other unit component failure occur during the life of the instrument, isolation and replacement may be accomplished by point-to-point circuit analyses by a qualified electronics technician using the circuit schematic for reference.

The Mark VI flashtube is a commercially available General Electric Type FT-118. To replace the tube, remove the gray-scale box and the Plexiglas tube shield and pull the tube out horizontally to the right (see Fig. 15).

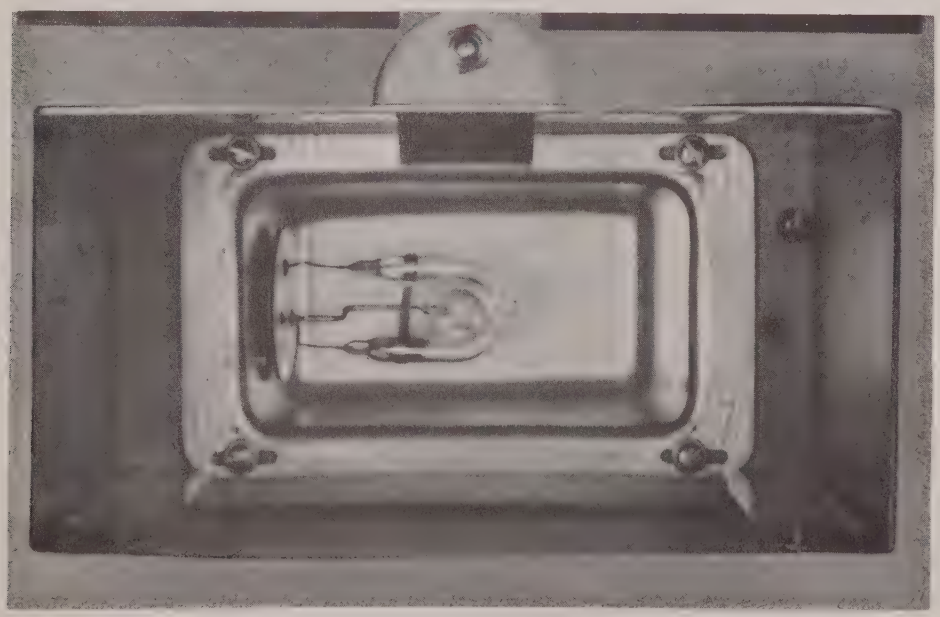

Fig. 15. Top view of Mark VI Sensitometer.

WARNING

There is danger of severe shock if the tube is removed immediately after use. To prevent shock, wait at least 2 minutes after operation before removing the tube.

The red dot at the top of the tube socket indicates the correct position for the trigger electrode. Insert the new tube with the trigger electrode at the top. Replace the tube shield and the gray-scale box, making sure the shield rests on its sponge rubber support.

Figure 16 is the circuit diagram for the sensitometer. If it is necessary to inspect or replace any of the electronic components, loosen the five screws on the bottom of the chassis and remove the base. The transformer is located in the upper portion of the unit and can be reached only after removal of the case. To remove the case, first detach the base, then loosen the two screws at the front of the instrument and the four screws under the cover. The case can then be lifted off easily.

WARNING

High voltage exists inside the unit. The bottom plate should not be removed, or servicing done, except by experienced personnel who have had instructions in the operation of the instrument.

The parts list for the Mark VI is included following the circuit schematic.

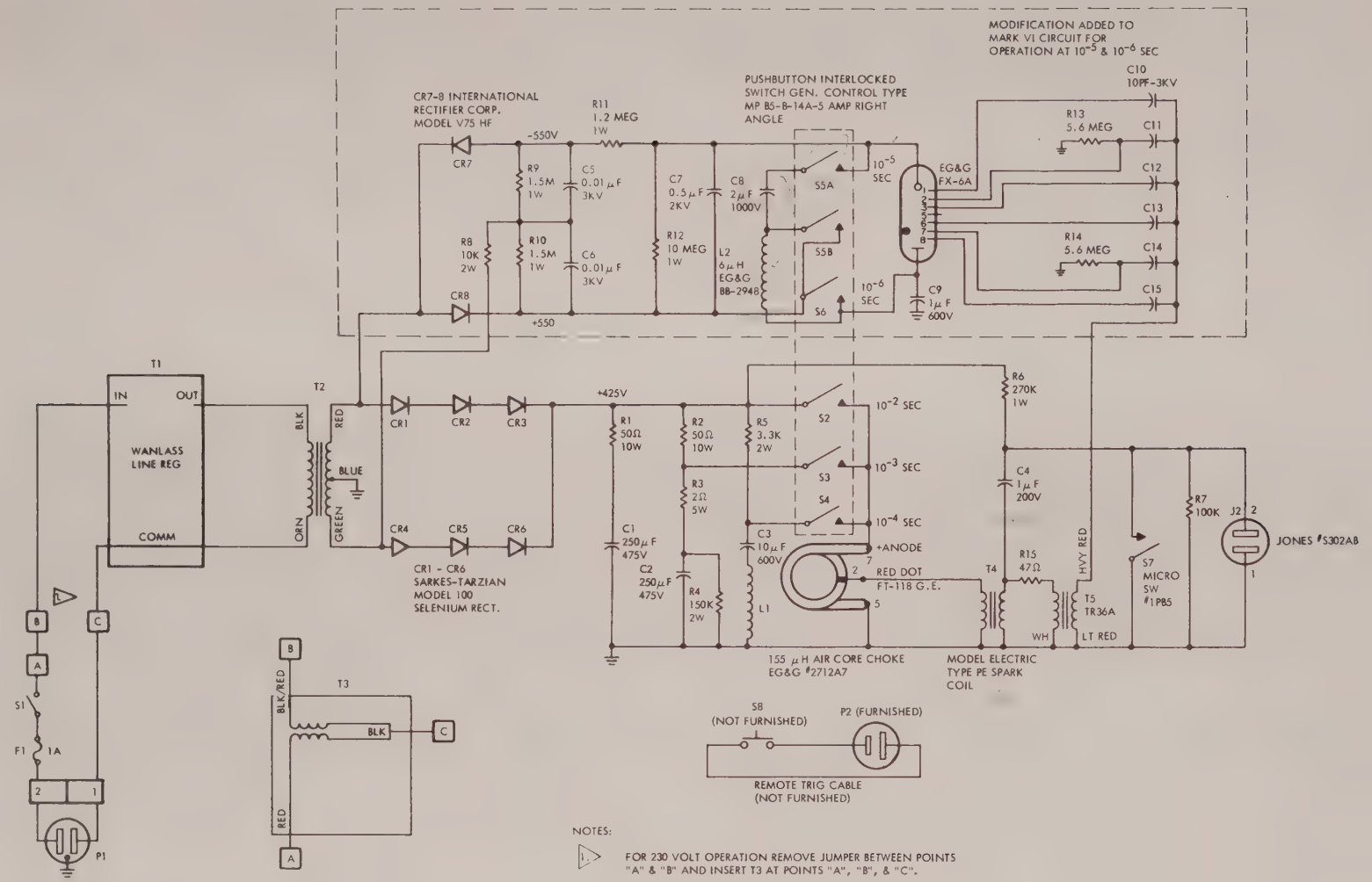
MODIFICATION ADDED TO MARK VI CIRCUIT FOR OPERATION AT 10⁻⁵ & 10⁻⁶ SEC
CR7-8 INTERNATIONAL RECTIFIER CORP. MODEL V75 HF
PUSHBUTTON INTERLOCKED SWITCH GEN. CONTROL TYPE MP B5-B-14A-5 AMP RIGHT ANGLE
EG&G FX-6A
-550V
+550
+425V
+ANODE
RED DOT
FT-118 G.E.
WANLASS LINE REG
IN
OUT
COMM
CR1 - CR6 SARKES-TARZIAN MODEL 100 SELENIUM RECT.
155 μH AIR CORE CHOKE EG&G #2712A7
MODEL ELECTRIC TYPE PE SPARK COIL
JONES #S302AB
S7 MICRO SW #1PB5
T5 TR36A
S8 (NOT FURNISHED)
P2 (FURNISHED)
REMOTE TRIG CABLE (NOT FURNISHED)
NOTES:
1. FOR 230 VOLT OPERATION REMOVE JUMPER BETWEEN POINTS "A" & "B" AND INSERT T3 AT POINTS "A", "B", & "C".

Fig. 16. Mark VI Sensitometer, schematic diagram.

The following table lists and identifies, by type and location, all of the maintenance parts that might require repair or replacement. All other parts not listed are either standard parts, structural parts, or parts without maintenance significance.

List of parts required for maintenance

Item	Description	Type	Value	Location	EG&G Stock No.
Input Power Cable	8' Belden Cord No. 1766B with Hubbell No. 5273-L	3-wire, grounded	115-V A-C	Chassis, base. Interior connection to 2-terminal H. H. Smith terminal board.	FF0015
Fuse (F1)	Littelfuse	Cartridge	3 AG, 1 AMP 250 V	Fuse clip, base assembly, bottom right rear.	DD0009
ON-OFF Switch (S6)	SPST No. 2099 ALH A. H. & H.	Toggle	1 AMP, 250 V	Protruding from cabinet face mounted on base assembly, right front.	SS0081
Transformer (T1)	Wanlass Line Reg.	CVR-120	115 V, 50/60 Hz	Mounted on top of base assembly exposed when case cover is removed.	TT0105
Transformer (T2)	Power Xfmr.	C305392		Mounted on top of base assembly exposed when case cover is removed.	TT0122
Charging Capacitors (C1, C2)	Sprague, Type No. 29D13		250 μF, 475-V D-C	Mounted on top of base assembly upper left, exposed with cover removed.	CC0278

Item	Description	Type	Value	Location	EG&G Stock No.
Charging Capacitor (C3)	Cornell-Dubilier CP70E1DF106K		10 μF, 600-V D-C	Mounted on top of base assembly upper right, exposed with cover removed.	CC0201
Charging Capacitor (C4)	Aerovox Type No. P92 ZN	Paper	1 μF, 200-V D-C	Mounted on front of assembly resistor board face, which is bolted to the bottom of the base assembly.	CC0176
Exposure Time Switches (3) (S1)(S2)(S3)	General Control No. MPB3-8-14-A	Push button automatic reset		Protrudes from cabinet face. Switch proper mounted on base assembly, front.	SS0020
Voltage Rectifiers (CR1-CR6)	Sarkes-Tarzian Model 100-150	Selenium		Mounted on rear of assembly resistor board, which is bolted to the base assembly.	AA0187
Resistors (R1, R2)	Ohmite	Brown Devil	50 ohm, 10 watt	Front of assembly resistor board.	RR1403
Resistor (R3)	Ohmite	Brown Devil	2 ohm, 5 watt	Front of assembly resistor board.	RR1201
Resistor (R4)	Ohmite	Molded	150K ohm, 2 watt, ±10%	Front of assembly resistor board.	RR1030
Resistor (R5)	Ohmite	Molded	3.3K ohm, 2 watt, ±10%	Front of assembly resistor board.	RR1017
Resistor (R7)	Ohmite	Molded	270K ohm, 1 watt, ±10%	Front of assembly resistor board.	RR0955
Resistor (R8)	Ohmite	Molded	100K ohm, 1 watt, ±10%	Front of assembly resistor board.	RR0954

Item	Description	Type	Value	Location	EG&G Stock No.
Resistor (R9)		Wire wound	400 ohm, 5 W	Under chassis.	RR1200
Trigger Switch (S5)	Microswitch No. 1PB5	Push button SPDT		Located under platen on top of case body.	SS0021
Flashtube	G. E. Type FT-118	Xenon, helical		Accessible from top of unit. Plugs into Cinch-Jones octal 8-pin socket mounted on base assembly.	AC0429
Choke (L1)	EG&G Type No. 2712A7	Air core	155 μH	Mounted on bottom left rear of base assembly.	XX0051
Socket (J2)	Cinch-Jones No. S-302AB	Two contact		Accessible on right side of cabinet. Mounted to base assembly and wired into S5 terminals.	
Gray Scale Box		BC2815			XX0044
Photographic Step Tablet		Kodak No. 2			XX0024
Compensator, 10^{-3}		A207762			XX0043
Compensator, 10^{-2}		A207763			XX0044
Flashtube Shield		BB51786			XX0074
Case Assembly		BD2440			XX0068
Base		BD2442			XX0069

4.2 TROUBLESHOOTING

The Mark VI Sensitometer can easily be serviced by trained electronics technicians using the troubleshooting chart and the circuit schematic for the unit (Fig. 16). No special tools or test instruments are required.

TROUBLESHOOTING CHART

Symptom	Possible Cause	Remedy
Low light output.	R1, R2, or R5* open. Check with ohmmeter.	Replace R1, R2, or R5.
	C1, C2, or C3 leaking or open circuit.	Replace C1, C2, or C3.
	CR1-CR6 open. Check with ohmmeter.	Replace CR1-CR6.
	Flashtube FT-118 worn out, visible deposits inside helix.	Replace FT-118.
	S1-S3, high resistance contacts, burnt contacts.	Replace switch assembly.
Intermittent flashes	Flashtube FT-118 at end of life; hard starting.	Replace FT-118.
	CR1-CR6 open or short circuit. Check with ohmmeter for B+.	Replace CR1-CR6.
	S5 contacts deteriorated. Measure with ohmmeter.	Replace S5.

*Parts identification is sufficiently detailed in the schematic diagram to allow replacement.

Symptom	Possible Cause	Remedy
Intermittent flashes (cont)	Modelectric Type PE spark coil.	Replace Type PE spark coil.
	C4 shorted or leaking. Check with ohmmeter.	Replace C4.
No flash	CR1-CR6 open or shorted. Check with ohmmeter.	Replace CR1-CR6.
	Fuse F1, 1A.	Replace fuse.
	Line Regulator Transformer, T1 defective.	Replace T1.
	Faulty line cord.	Replace or repair line cord.
	S6 not contacting.	Replace S6.
	Switches S1-S3 not contacting.	Replace switch assembly.
	S5 not contacting.	Replace S5.
	C4 open or leaking.	Replace C4.
	Modelectric Type PE spark coil defective.	Replace Type PE spark coil.
	R1, R2, R3, R5 open circuit. Check with ohmmeter.	Replace faulty resistors.
	C1, C2, or C3 defective.	Replace C1, C2, or C3.
	Flashtube FT-118 defective.	Replace FT-118.
	Power Xfmr, T2 defective.	Replace T2.

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